Rules: ☑ CSR H	**CSR for Bulk Carriers and Oil Tankers assessment within MARS**	DV July 2015
Reference:	[Harmonised] Common Structural Rules for Bulk Carriers and Oil Tankers: • Edition – January 2015	
		DEV/UG/Mars2000/M007 rev3

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1. Introduction

This note presents the additional elements necessary to assess the IACS Common Structural Rules for Bulk Carriers and Oil Tankers (a.k.a. CSR "Harmonised", a.k.a. CSR H), Edition January 2015, Entry into Force July 1st 2015, compared to the previous Common Structural Rules (CSR), Edition July 2012.

Users not familiar with MARS 2000 should refer to the general user manual first.

2. Overview

MARS 2000 contains a complete package to assess the prescriptive requirements of the CSR H:

- Global strength criteria (yielding, ultimate and residual strength),
- Local scantling of strakes, longitudinal and transverse stiffeners for cross sections (minimum, yielding and buckling criteria),
- Fatigue calculations of connections between longitudinal stiffeners and primary structure,
- Local scantling of strakes and secondary stiffeners for transverse bulkheads (minimum and yielding criteria).

In addition there are specific requirements by type of ship:

- For Bulk Carriers:
  - Assessment of the side frames for single sided bulk carriers,
  - Grab load assessment.
- For Oil Tankers:
  - Assessment of the Primary Supporting Members (PSM) ring.

Part 3 of this document describes the new data that needs to be input compared to an already defined CSR Bulk Carrier or CSR Double Hull Oil Tanker ship project in MARS 2000. Part 4 outlines the calculation options and results. Appendix A sums-up the requirements and their presence in MARS 2000.

3. New Data Input

3.1. Basic Ship Data

3.1.1. Activating the CSR H

Since version 2.9a of MARS 2000, new databases created for ships having the service notation “Bulk Carrier CSR” or “Oil Tanker CSR” will be assessed according to the CSR H rules.

Databases created before version 2.9a will keep their assessment under CSR “old” rules or CSR H according to how they have been defined.

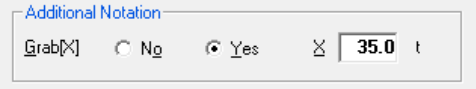
NOTE: To check a newly created database under the CSR BC or CSR OT rules, tick the “Apply CSR BC/OT – Edition July 2012” option.

3.1.2. Notations and Main Data

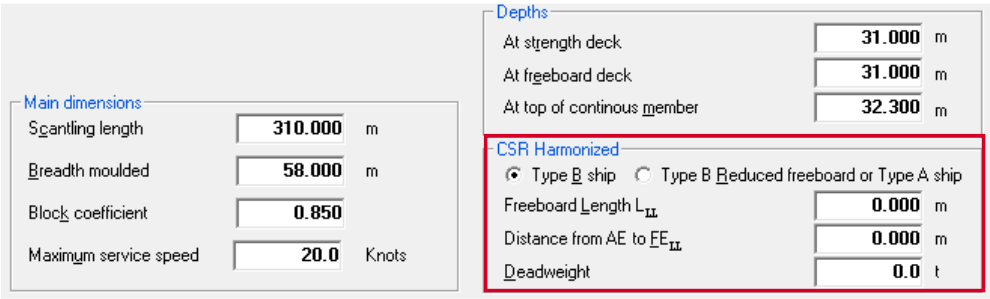
The great majority of the notations and main data are the same as every other MARS 2000 database.

However, two inputs can be pointed out at this level:

- For Bulk Carrier ships: for the additional class notation Grab, there is a minimum grab weight function of the rule length of ship in the CSR H rules (ref: Pt 1, Ch 1, Sec1, 3.2.2). This minimum will be effective within the input field and will also be re-evaluated afterwards within the calculations.



- For Oil Tanker ships: additional data is required to compute the green sea pressures (ref: Pt 1, Ch 4, Sec 5, 2.2). Those data were already an input for CSR Bulk Carriers.



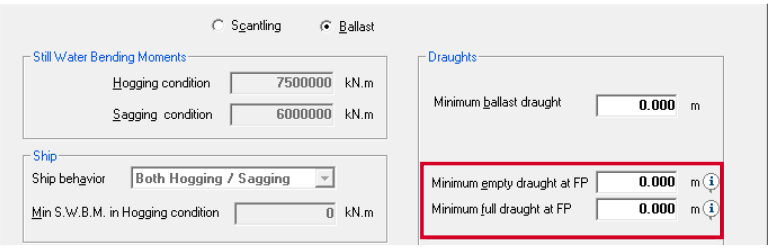
NOTE: If the freeboard length L_{LL} is not set, the calculations will be done using the scantling length. If the field distance from AE to FE_{LL} is left empty, it will be taken equal to L_{LL}.

3.1.3. Additional draughts for Bottom Slamming Assessment

The assessment of the bottom slamming criteria (ref: Pt 1, Ch 10, Sec 1, 3.2) will be automatically triggered in the relevant sections by the input of two new ballast draughts (ref: Pt 1, Ch 4, Sec 5, 3.2.1):

Minimum empty draught at FP (m): Design slamming draught at the forward perpendicular (FP) defined as the minimum draught at the FP indicated in the loading manual for all seagoing conditions where any of the ballast tanks within the bottom slamming region are empty including all loading conditions with tanks inside the bottom slamming region that use the 'sequential' ballast water exchange method.

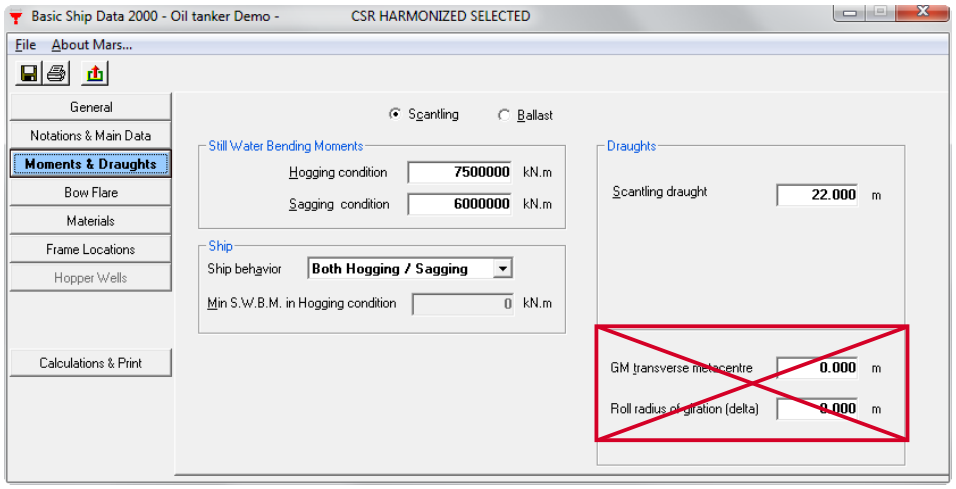
Minimum full draught at FP (m): Design slamming draught at the FP defined as the minimum draught at the FP indicated in the loading manual for all seagoing conditions where all ballast tanks within the bottom slamming region are full including all loading conditions with tanks inside the bottom slamming region that use the 'flow-through' ballast water exchange method.



NOTE: If these draughts are left empty, no bottom slamming assessment will be performed within the database project.

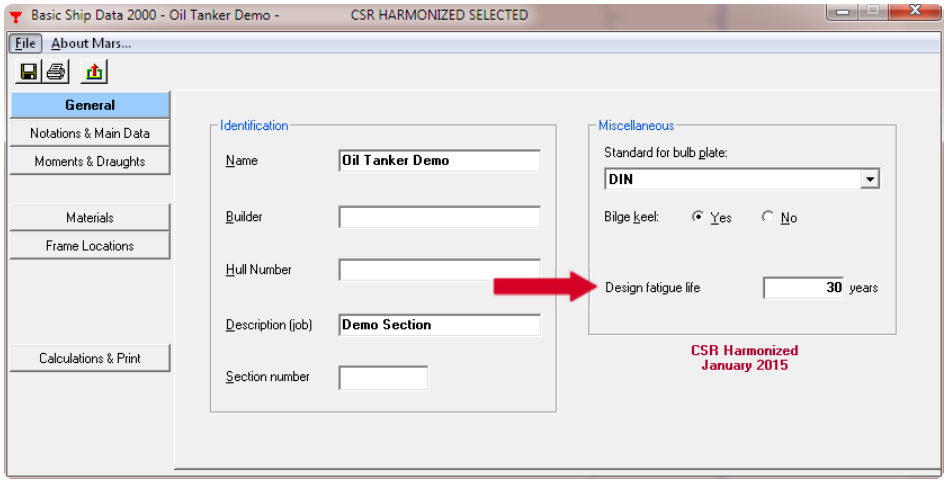
3.1.4. GM and roll radius

The CSR H rules fix the values of GM and roll radius to be used (ref: Pt 1, Ch 4, Sec 3, Tables 1 & 2) so it is not a necessary input for CSR H databases.



3.1.5. Design Fatigue Life

For fatigue assessment, it is possible to input the Design Fatigue Life (ref: Pt 1, Ch 9, Sec 1, Symbols):



NOTE: If this field is left empty, the reference minimum of 25 years will be taken as Design Fatigue Life within the calculations.

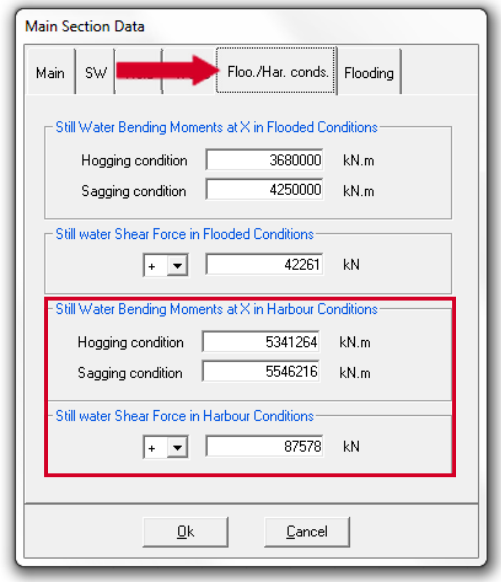
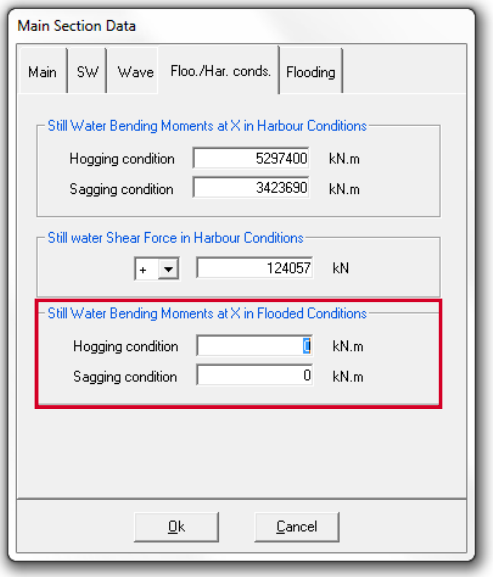
3.2. Section's Input data

The objective of this document being to highlight the new inputs needed for a proper CSR H assessment, it is recommended to refer to the MARS 2000 User Manual as the basic input process will not be explained hereafter.

3.2.1. Main Section Data

▸ Flooding and Harbour conditions

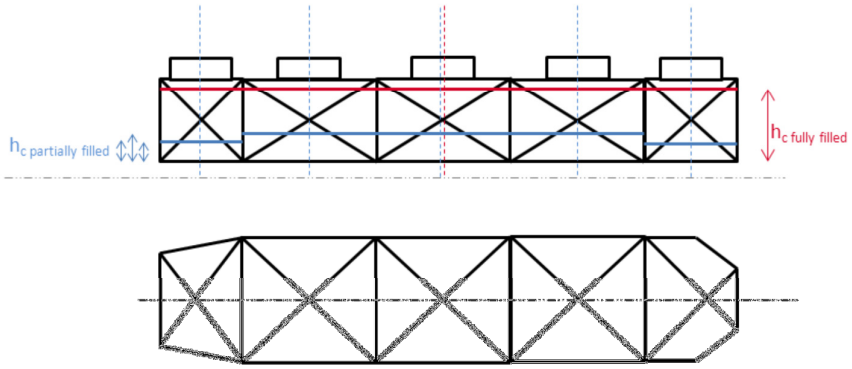
It is necessary to input some still water bending moments and shear forces for each section in Flooded and Harbour.
For the previous CSR only one of those conditions was necessary.

Bulk Carrier Ships	*Oil Tanker ships*
	

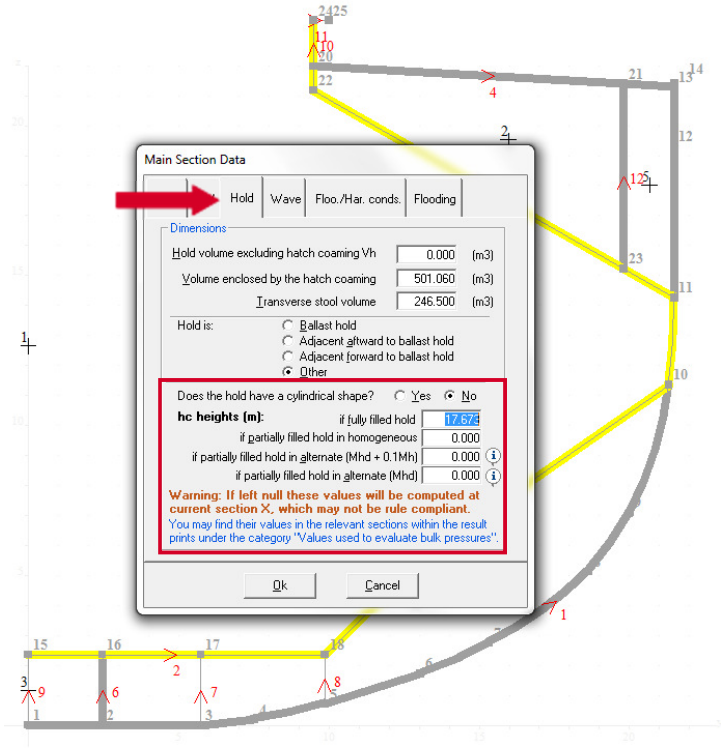
▸ Hold data for Bulk Carrier ships

The height of bulk cargo h_c, for the evaluation of bulk pressures, as stated by the CSR H rules (ref: Pt 1, Ch 4, Sec 6, 2.3.1 & 2.3.2) is to be computed at:

- At mid length of the cargo hold at the midship for a fully filled cargo holds,
- At mid length of the considered cargo hold for any partially filled cargo holds.



MARS 2000 having unlinked sections, it is necessary to input the heights of bulk cargo into sections where the geometry of the current section is not the correct one to evaluate h_c.


Main Section Data
Hold
Wave
Floo./Har. conds.
Flooding
Dimensions
Hold volume excluding hatch coaming Vh 0.000 (m3)
Volume enclosed by the hatch coaming 501.060 (m3)
Transverse stool volume 246.500 (m3)
Hold is:
Ballast hold
Adjacent aftward to ballast hold
Adjacent forward to ballast hold
Other
Does the hold have a cylindrical shape? Yes No
hc heights (m):
if fully filled hold 17.675
if partially filled hold in homogeneous 0.000
if partially filled hold in alternate (Mhd + 0.1Mh) 0.000
if partially filled hold in alternate (Mhd) 0.000
Warning: If left null these values will be computed at current section X, which may not be rule compliant.
You may find their values in the relevant sections within the result prints under the category "Values used to evaluate bulk pressures".
Ok
Cancel

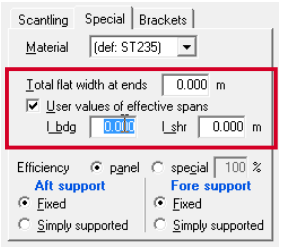
NOTE: Part 4.2.2 of this Memo explains how to retrieve those values from the appropriate MARS 2000 sections.

3.2.2. Effective spans of stiffeners

MARS 2000 works with an approximate method relative to the CSR H rules (ref: Pt 1, Ch 3, Sec 7, 1.1) to evaluate the effective bending span, ℓ_{bdg}, and the effective shear span, ℓ_{shr}, of ordinary stiffeners. Such method is described in Appendix C.

If, for a given stiffener, this approximation is not accurate enough to perform the assessments, it is possible to overwrite the effective spans values used by the software.

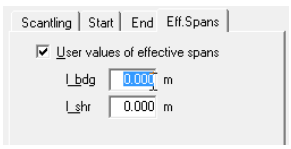
- For longitudinal stiffeners



In the “Special” tab of the longitudinal stiffeners form, tick the checkbox “User values of effective spans” to input the values wanted.

NOTE: if this option is used but one of the effective span values is left equal to 0: MARS 2000 will use its default value instead.

- For transverse stiffeners



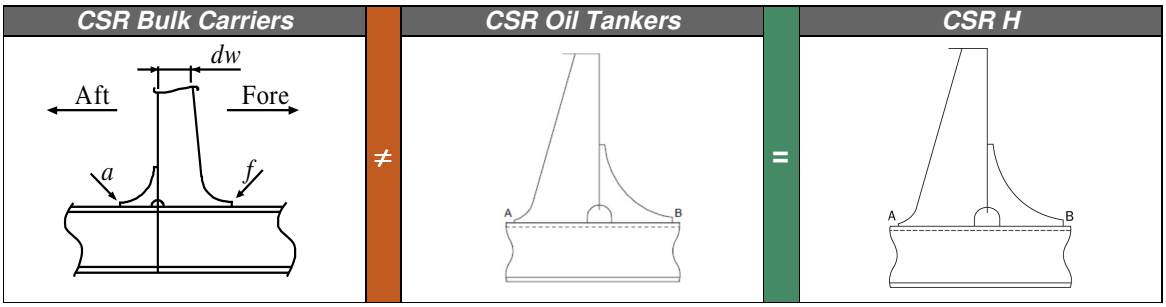
For transverse stiffeners, this information is contained in the “Eff. Spans” tab.

NOTE: if this option is used but one of the effective span values is left equal to 0: MARS 2000 will use its default value instead.

3.2.3. Data for Fatigue evaluation

Connection data

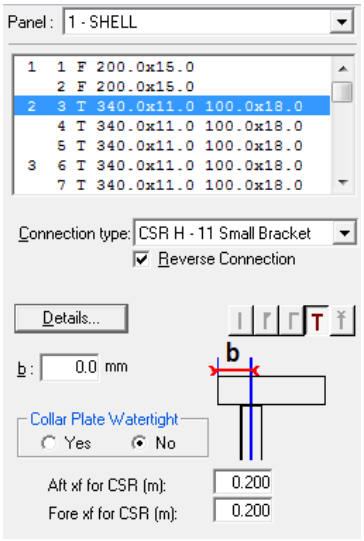
It should be noticed at first that the three Common Structural Rules don't have the same convention as shown in the following example:



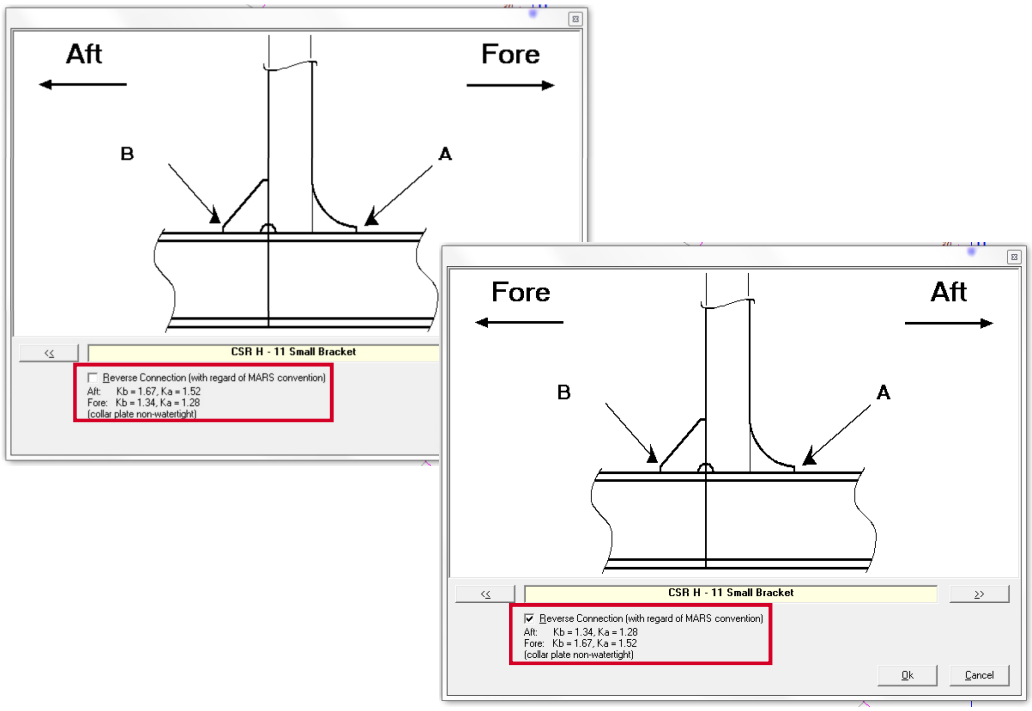
Within MARS 2000, data is made as independent as possible from any given rule set. As a consequence, it is sought after to ensure a two-way compatibility between older databases and newer ones, as well as within a database given a different rule set.

This means that compared to the provided list of connection types with the CSR H (ref: Pt 1, Ch 9, Sec 4, Table 4):

- Watertight and non-watertight equivalent types are regrouped,
- Some types are divided according to bracket size,
- There is a "*Reverse connection*" information in order to adapt the current detail according to MARS 2000 convention. In that respect, MARS 2000 follows CSR Bulk Carrier convention ("a" Aft / "f" Fore), which means regarding the CSR H convention that the "B" is Aft whether "A" is Fore.



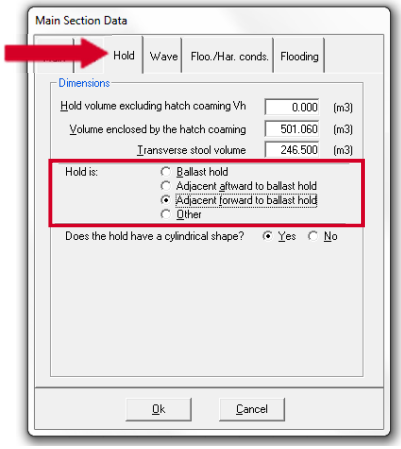
It is possible to check through the "Details" button, if the concentration factors displayed (and later used) are those expected.



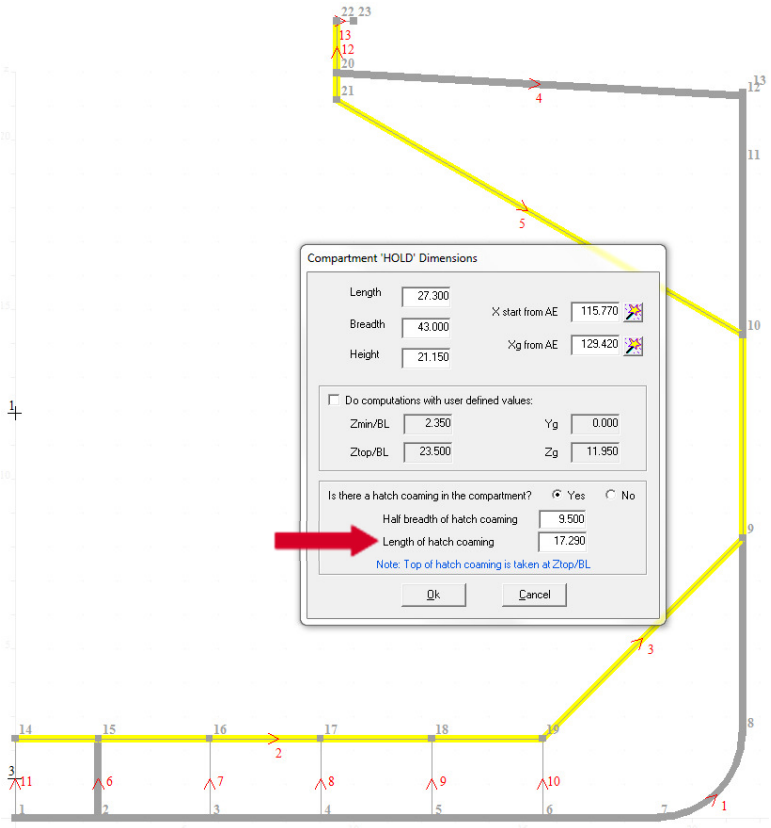
▸ Additional fatigue data for Bulk Carrier ships

Two additional data are required for the fatigue calculations linked to the ballast hold.

- In the Hold data of the Main Section data, it is necessary to define whether the current section is in way of the ballast hold, in a hold adjacent to it or not. This is needed for the evaluation of the fraction of permissible still water vertical bending moment (ref: Pt 1, Ch 9, Sec 4, 3.2.1).

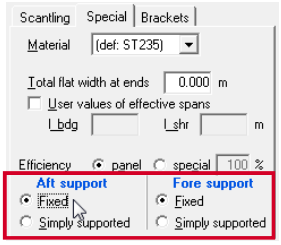
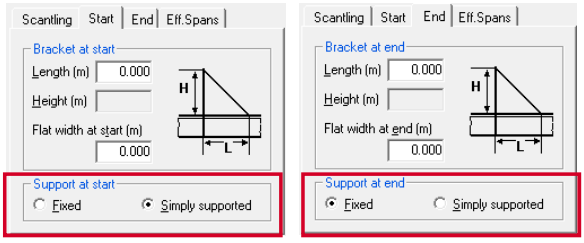


- For sections in way of the ballast hold, in the compartment dimensions data, it is necessary to input the value of the length of the hatch coaming in order to calculate the longitudinal ullage factor of the liquid dynamic pressures for the fatigue check (ref: Pt 1, Ch 4, Sec 6, 1.3.1)



3.2.4. Fixed/Simply supported input on stiffeners

There is an input to describe the supports at both ends of ordinary stiffeners. This information is independent from the definition of the efficiency (longitudinal stiffeners only) and flat at ends / brackets.

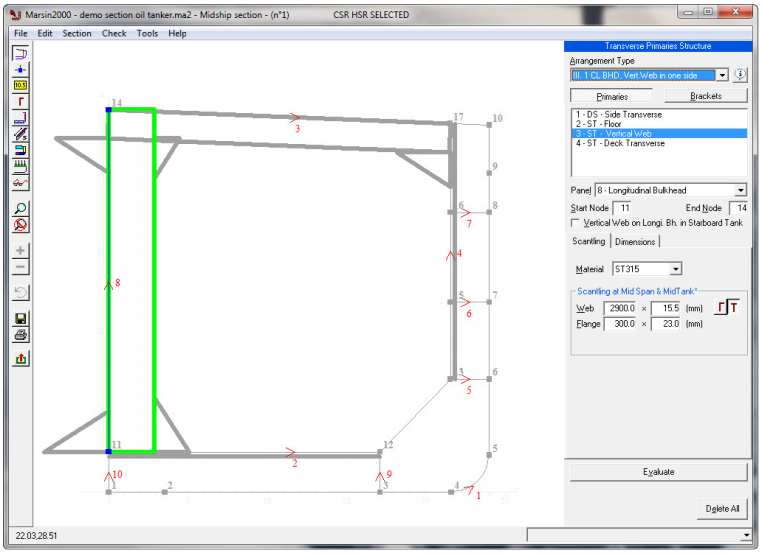
Longitudinal stiffeners	*Transverse stiffeners*
	

It will be used for the following assessments:

- Evaluation of the F_{long} coefficient for buckling on the EPPs adjacent to the stiffener (ref: Pt 1, Ch 8, Sec 5, Table 2) –longitudinal stiffeners only–
- Evaluation of the ℓ_{eff} effective length of stiffener for buckling (ref: Pt 1, Ch 8, Sec 5, 2.3.5)
- Assessment of the stiffener under bottom slamming pressure (ref: Pt 1, Ch 10, Sec 1, 3.2.5 & Ch 3, Sec 7, 1.4.6)
- Assessment of the stiffener under sloshing pressures (ref: Pt 1, Ch 10, Sec 4, Table 2) – longitudinal stiffeners only–

3.2.5. Oil Tankers Primary Supporting Members

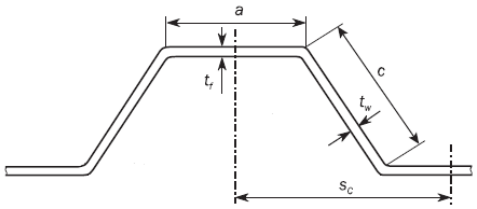
Please refer to the Memo “CSR for Oil Tankers Primary Supporting Members Assessment with MARS” (reference: DEV/UG/Mars2000/M006) regarding the input of PSM ring.


Marsin2000 - demo section oil tanker.ma2 - Midship section - (n°1)
CSR HSR SELECTED
File Edit Section Check Tools Help
Transverse Primaries Structure
Arrangement Type
III. 1 CL BHD: Vert.Web in one side
Primaries
Brackets
1 - DS - Side Transverse
2 - ST - Floor
3 - ST - Vertical Web
4 - ST - Deck Transverse
Panel 8 - Longitudinal Bulkhead
Start Node 11
End Node 14
Vertical Web on Longi. Bh. in Starboard Tank
Scantling
Dimensions
Material ST315
Scantling at Mid Span & MidTank*
Web 2900.0 x 15.5 (mm)
Flange 300.0 x 23.0 (mm)
Evaluate
Delete All
22.03,28.51

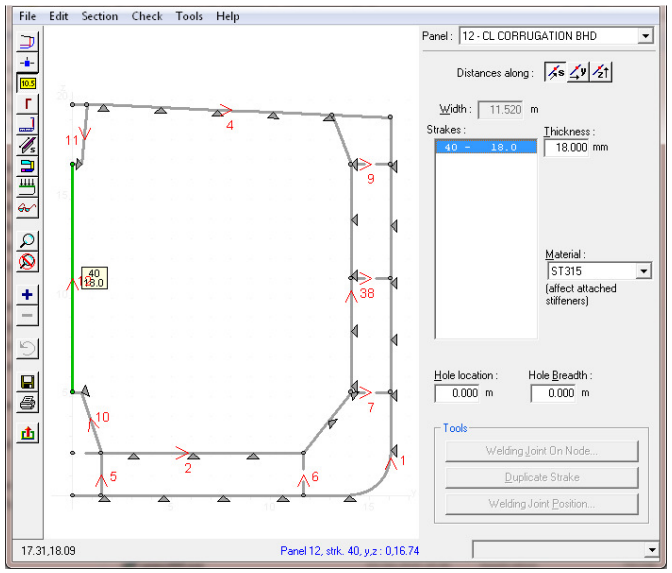
3.2.6. Oil Tankers with longitudinal vertically corrugated bulkhead

In case there is a longitudinal vertically corrugated bulkhead on the cross section, the plate thickness to input is order for MARS 2000 to compute the correct shear flow (ref: Pt 1, Ch 5, App 1, 1.2.1) is the equivalent gross thickness defined by:

$$t_{cor-gr} = \frac{t_{w-gr} + t_{f-gr}}{2} \cdot \frac{s_c}{c + a}$$



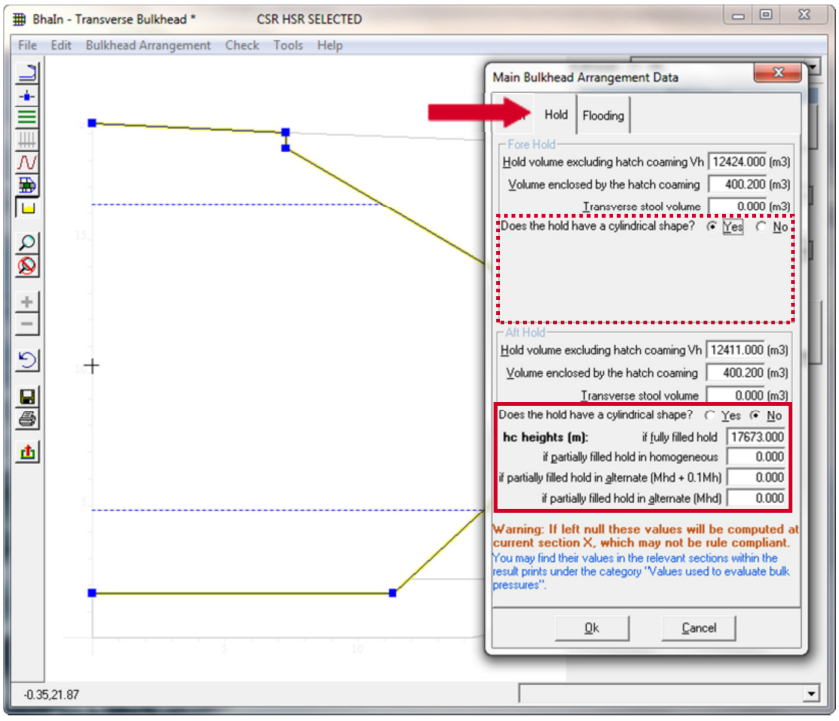
(deduced in accordance with Pt 1, Ch 5, Sec 1, 3.4.6)



3.3. Bulkhead Arrangement's Input data

3.3.1. Main Data

For Bulk Carrier ships, and as mentioned in Part 3.2.1 of this document, it might be necessary to input the heights of the bulk cargo.

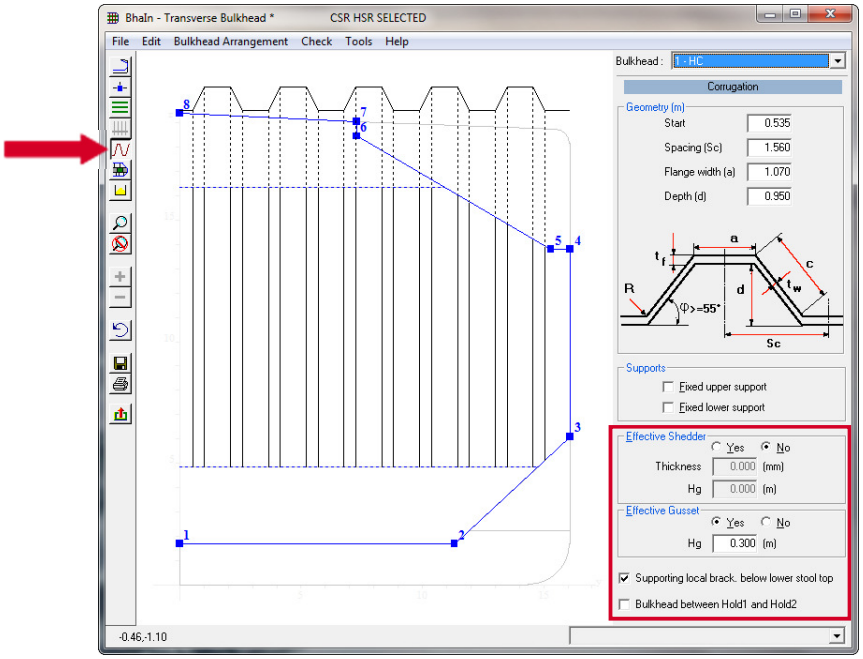

Bhaln - Transverse Bulkhead *
CSR HSR SELECTED
File Edit Bulkhead Arrangement Check Tools Help
Main Bulkhead Arrangement Data
Hold
Flooding
Fore Hold
Hold volume excluding hatch coaming Vh 12424.000 (m3)
Volume enclosed by the hatch coaming 400.200 (m3)
Transverse stool volume 0.000 (m3)
Does the hold have a cylindrical shape? Yes No
Aft Hold
Hold volume excluding hatch coaming Vh 12411.000 (m3)
Volume enclosed by the hatch coaming 400.200 (m3)
Transverse stool volume 0.000 (m3)
Does the hold have a cylindrical shape? Yes No
hc heights (m): if fully filled hold 17673.000
if partially filled hold in homogeneous 0.000
if partially filled hold in alternate (Mhd + 0.1Mh) 0.000
if partially filled hold in alternate (Mhd) 0.000
Warning: If left null these values will be computed at current section X, which may not be rule compliant.
You may find their values in the relevant sections within the result prints under the category "Values used to evaluate bulk pressures".
Ok
Cancel
-0.35,21.87

3.3.2. Specific data for corrugated bulkheads

This is only a reminder as these inputs already existed for the previous CSR.

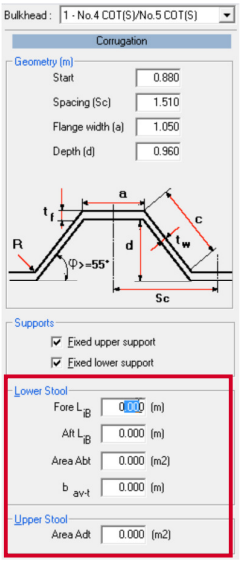
- For Bulk Carrier ships

For the assessment of transverse vertically corrugated watertight bulkheads separating cargo holds in flooded conditions (ref: Pt 2, Ch 1, Sec 3, 3) it is necessary to input additional data to better describe the corrugated bulkhead.



For Oil Tanker ships

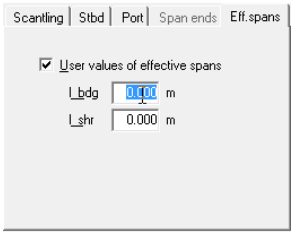
Similarly, for the assessment of vertically corrugated bulkheads of Oil Tanker ships (ref: Pt 2, Ch 2, Sec 3, 2), some additional data are required.



3.3.1. Effective spans of mono-span stiffeners

MARS 2000 works with an approximate method relative to the CSR H rules (ref: Pt 1, Ch 3, Sec 7, 1.1) to evaluate the effective bending span, ℓ_{bdg}, and the effective shear span, ℓ_{shr}, of mono-span stiffeners. Such method is described in Appendix C.

If, for a given stiffener, this approximation is not accurate enough to perform the assessments, it is possible to overwrite the effective spans values used by the software.



The “Eff.spans” tab gives access to a checkbox to tick for activating the effective spans’ user values to be input.

NOTE: if this option is used but one of the effective span values is left equal to 0: MARS 2000 will use its default value instead.

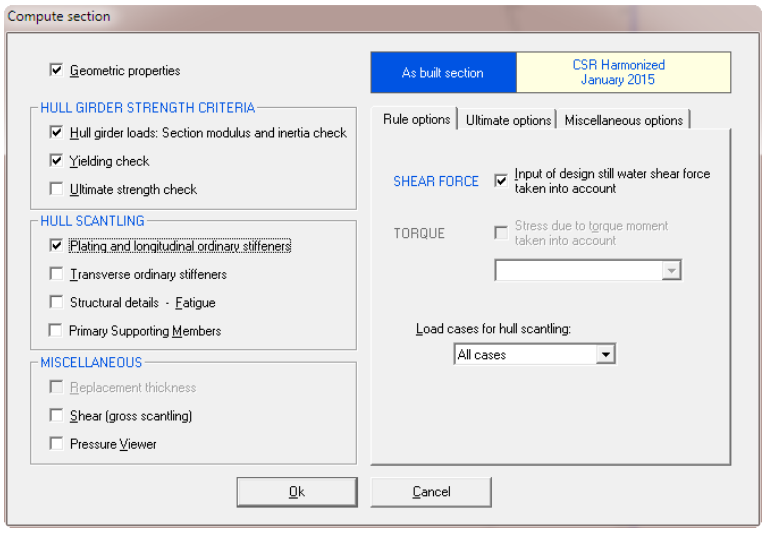
Reminder: For multi-span stiffeners, MARS 2000 proceeds to their assessment by direct calculation (loaded beam over several supports): so this input is not relevant (and therefore disabled).

4. Results

4.1. Calculation options for Sections

4.1.1. General Options

Before running the assessment of a section, it is possible to choose over several checks and calculations to be performed.



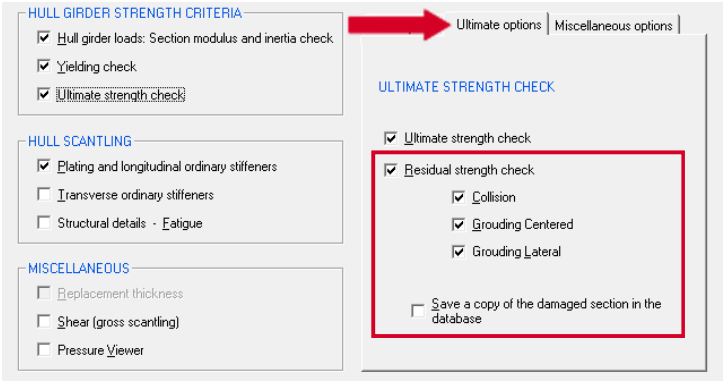
4.1.2. Specific assessment options

Two sets of options need to be highlighted in the CSR H rules context.

- Residual Strength options

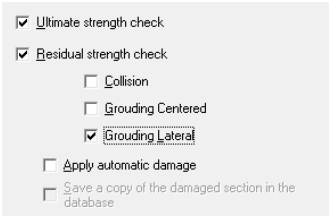
Associated to the Ultimate Strength check, it is possible for a given section to run in addition several cases of Residual Strength.

For sections defined over a half-section, the damages will be automatically applied. It is possible to store a copy of the damaged section as a new section in the current MARS 2000 database.



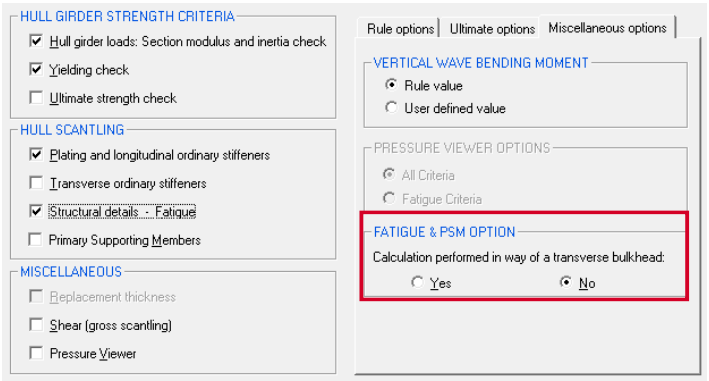
In the case of full sections:

- Either the section represents an already damaged section, where damages have been applied manually or are coming from a copy of an automatically damaged half section, and in that case it is necessary to choose the one case of damage it represents,
- Either, the section needs to have the damages automatically applied and in that case several damage cases can be run.



▸ Miscellaneous option for Oil Tanker ships

For fatigue criteria (K_d factor evaluation as per Pt 1, Ch 9, Sec 4, 4.2.4) and/or PSM assessment (deck transverse adjacent to transverse bulkhead as per Pt 2, Ch 2, Sec 3, 1.5.5) it is necessary to indicate whether the current section is in way of a transverse bulkhead or not.



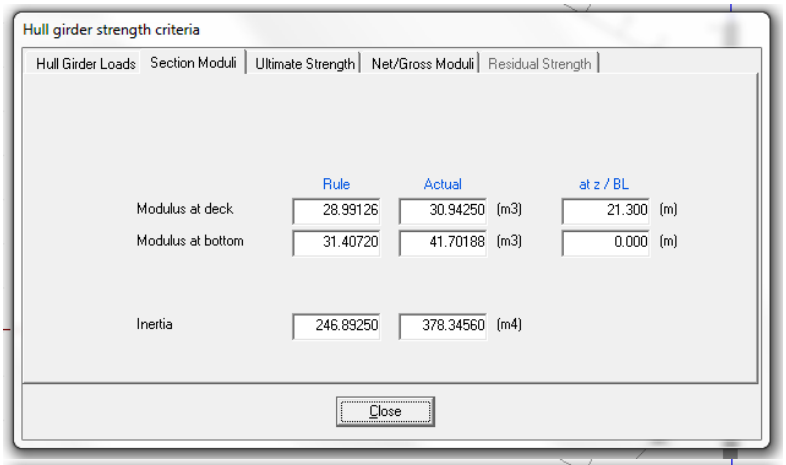
4.2. Results for Sections

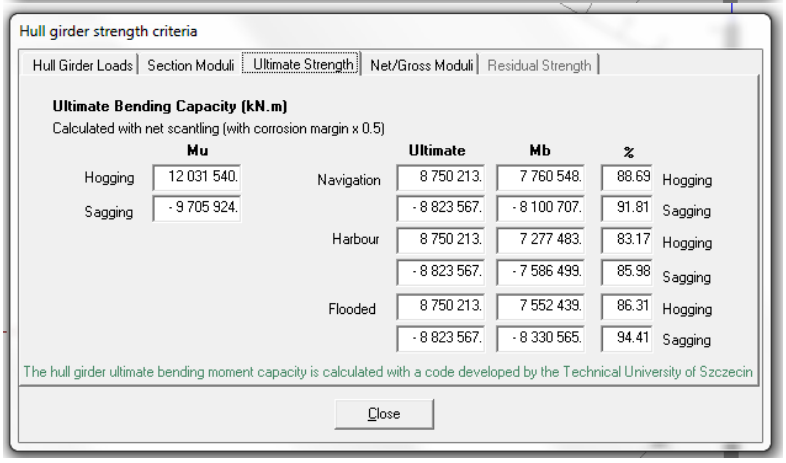
Here is just an overview of the CSR H results displays as they are greatly similar to what existed before in MARS 2000. It is recommended to turn to the MARS 2000 User Manual if more insight is needed.

4.2.1. Results display

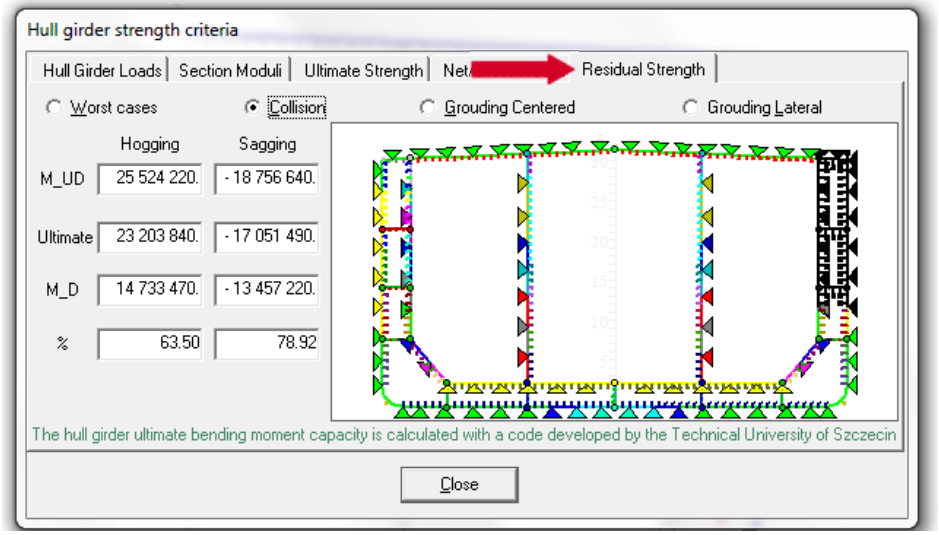
▸ Global Strength assessment

They regroup the section moduli and the ultimate strength results, if computed, as well as the residual strength results, if that option has been chosen.



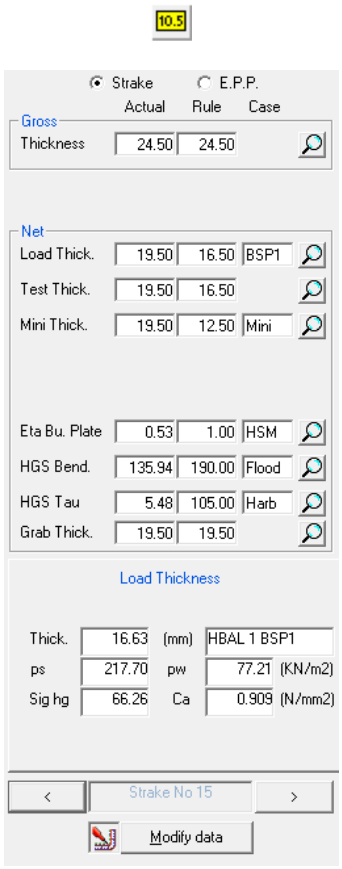
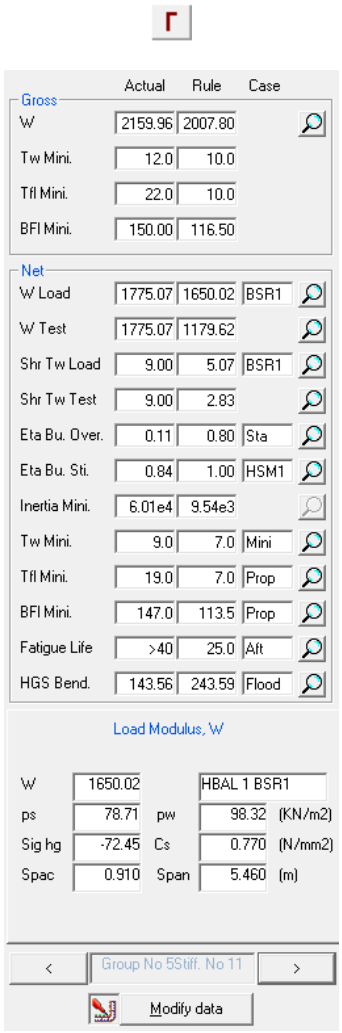
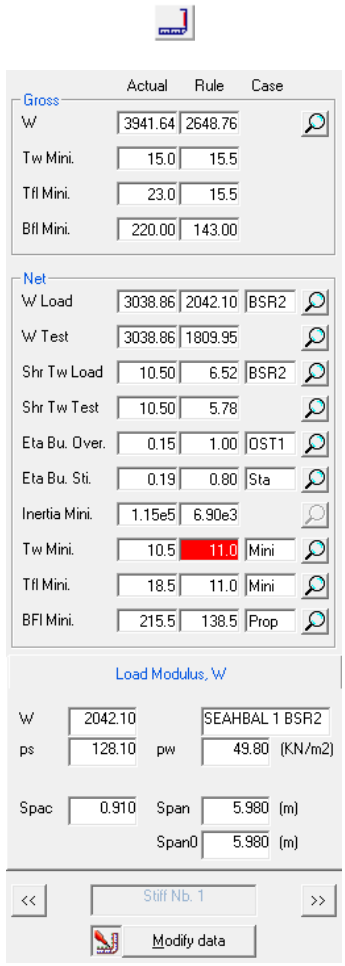


The residual strength is a new result display needed for CSR H rules. It provides a synthesis over all damage cases run, as well as the results values and a sketch of the section for each damage case.



▸ Local criteria

They regroup the minimum scantlings, yielding and buckling checks as well as the local expression of the hull girder strength criteria or any other specific criteria (plate thickness under grab requirement for Bulk Carrier ships, fatigue criteria for longitudinal stiffeners, etc.)

Plating	*Longitudinal Stiffeners*	*Transverse Stiffeners*
		

Strake
E.P.P.
Actual Rule Case
Gross
Thickness 24.50 24.50
Net
Load Thick. 19.50 16.50 BSP1
Test Thick. 19.50 16.50
Mini Thick. 19.50 12.50 Mini
Eta Bu. Plate 0.53 1.00 HSM
HGS Bend. 135.94 190.00 Flood
HGS Tau 5.48 105.00 Harb
Grab Thick. 19.50 19.50
Load Thickness
Thick. 16.63 (mm) HBAL 1 BSP1
ps 217.70 pw 77.21 (KN/m2)
Sig hg 66.26 Ca 0.909 (N/mm2)
Strake No 15
Modify data
Actual Rule Case
Gross
W 2159.96 2007.80
Tw Mini. 12.0 10.0
Tfl Mini. 22.0 10.0
Bfl Mini. 150.00 116.50
Net
W Load 1775.07 1650.02 BSR1
W Test 1775.07 1179.62
Shr Tw Load 9.00 5.07 BSR1
Shr Tw Test 9.00 2.83
Eta Bu. Over. 0.11 0.80 Sta
Eta Bu. Sti. 0.84 1.00 HSM1
Inertia Mini. 6.01e4 9.54e3
Tw Mini. 9.0 7.0 Mini
Tfl Mini. 19.0 7.0 Prop
Bfl Mini. 147.0 113.5 Prop
Fatigue Life >40 25.0 Aft
HGS Bend. 143.56 243.59 Flood
Load Modulus, W
W 1650.02 HBAL 1 BSR1
ps 78.71 pw 98.32 (KN/m2)
Sig hg -72.45 Cs 0.770 (N/mm2)
Spac 0.910 Span 5.460 (m)
Group No 5Stiff. No 11
Modify data
Actual Rule Case
Gross
W 3941.64 2648.76
Tw Mini. 15.0 15.5
Tfl Mini. 23.0 15.5
Bfl Mini. 220.00 143.00
Net
W Load 3038.86 2042.10 BSR2
W Test 3038.86 1809.95
Shr Tw Load 10.50 6.52 BSR2
Shr Tw Test 10.50 5.78
Eta Bu. Over. 0.15 1.00 OST1
Eta Bu. Sti. 0.19 0.80 Sta
Inertia Mini. 1.15e5 6.90e3
Tw Mini. 10.5 11.0 Mini
Tfl Mini. 18.5 11.0 Mini
Bfl Mini. 215.5 138.5 Prop
Load Modulus, W
W 2042.10 SEAHBAL 1 BSR2
ps 128.10 pw 49.80 (KN/m2)
Spac 0.910 Span 5.980 (m)
Span0 5.980 (m)
Stiff Nb. 1
Modify data

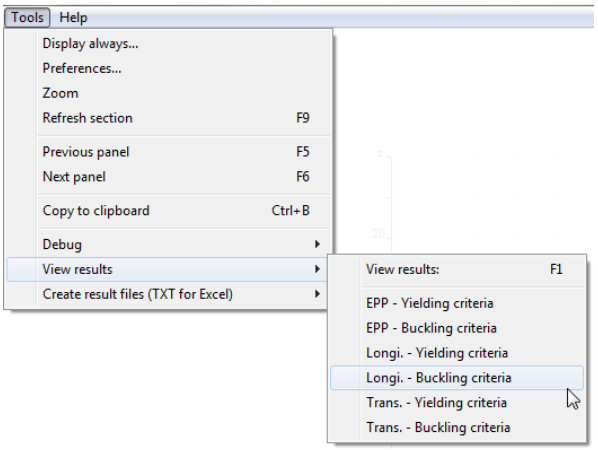
NOTE: The dominant case labelling of the yielding checks is explained in Appendix B.

4.2.2. Additional intermediate results

The results prints and the view results files can provide additional result values. Two examples will be given here.

▸ All load cases values

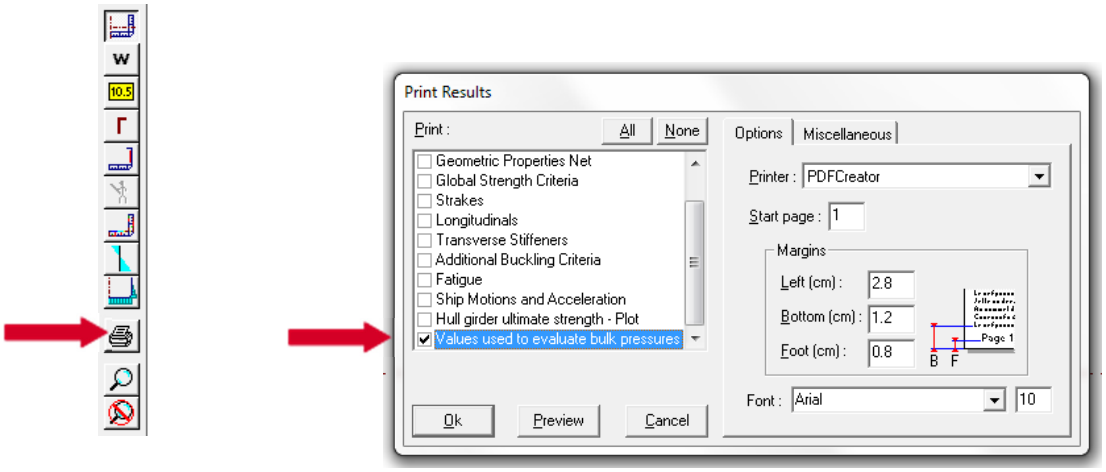
It might be of interest to check the non-dominant load cases for a given element and a given criteria. Several files give access to the complete set of load cases run. They are available under the menu “Tools” ➔ “View Results”.

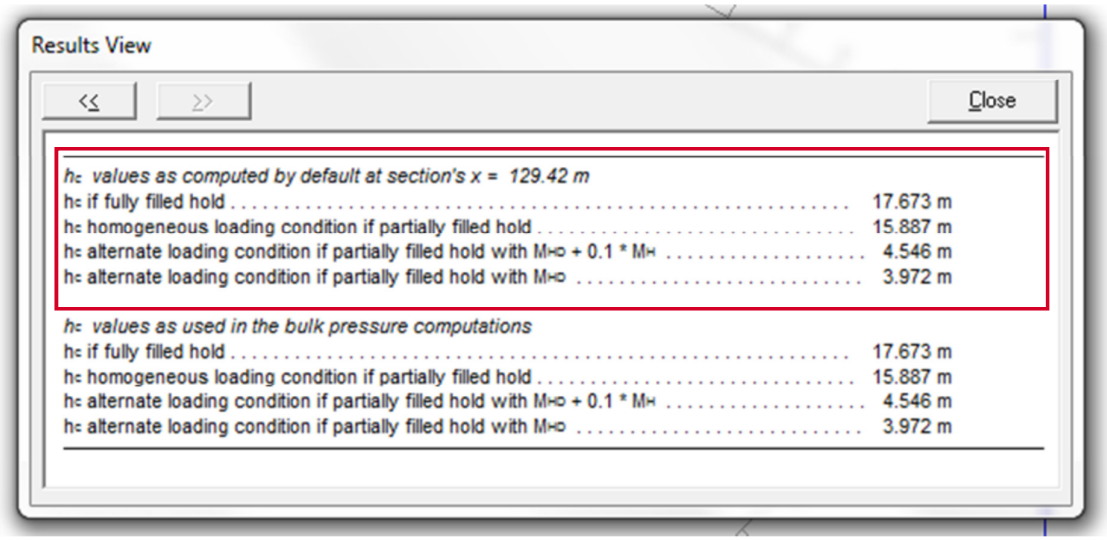


Panel : 1	Strake : 1	E.P.P. : 1	Spac :0.820	Span :1.365	Yc :0.820	zc :0.000		
Ps	Pw	Type	NCase	SigX1	Tau1	TLoad	Max	
150.829	-20.439	SEA	HSM1	173.867	0	8.659		At T_sc
150.829	20.439	SEA	HSM2	-166.75	0	9.853		
150.829	-16.351	SEA	HSA1	143.289	0	8.53		
150.829	16.351	SEA	HSA2	-137.731	0	9.461		
150.829	-30.22	SEA	FSM1	173.867	0	8.328		
150.829	30.22	SEA	FSM2	-166.75	0	10.13	*	
150.829	12.983	SEA	BSR1 P	79.94	0	8.887		
150.829	-12.983	SEA	BSR2 P	-77.606	0	8.136		
150.829	8.267	SEA	BSR1 S	80.247	0	8.761		
150.829	-8.267	SEA	BSR2 S	-77.913	0	8.277		
150.829	18.204	SEA	BSP1 P	112.71	0	9.294		
150.829	-18.204	SEA	BSP2 P	-108.713	0	8.202		
150.829	15.872	SEA	BSP1 S	112.71	0	9.229		
150.829	-15.872	SEA	BSP2 S	-108.713	0	8.274		
150.829	-14.073	SEA	OST1 P	124.629	0	8.452		
150.829	14.073	SEA	OST2 P	-120.111	0	9.242		
150.829	-12.345	SEA	OST1 S	121.178	0	8.478		
150.829	12.345	SEA	OST2 S	-116.66	0	9.164		
150.829	16.566	SEA	OSA1 P	-95.641	0	9.108		
150.829	-16.566	SEA	OSA2 P	98.859	0	8.18		
150.829	14.801	SEA	OSA1 S	-92.765	0	9.037		
150.829	-14.801	SEA	OSA2 S	95.983	0	8.213		
150.829	0	SEA S	Sta	132.997	0	9.872		At T_sc

▸ Heights of bulk cargo for Bulk Carrier ships

As mentioned in Parts 3.2.1 & 3.3.1 of this document, it might be necessary to transfer some h_c values between sections. The values that need to be retrieved from the appropriate sections are available in the results prints under the option “Values used to evaluate bulk pressures”.

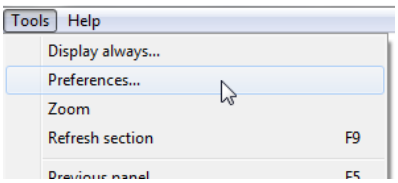


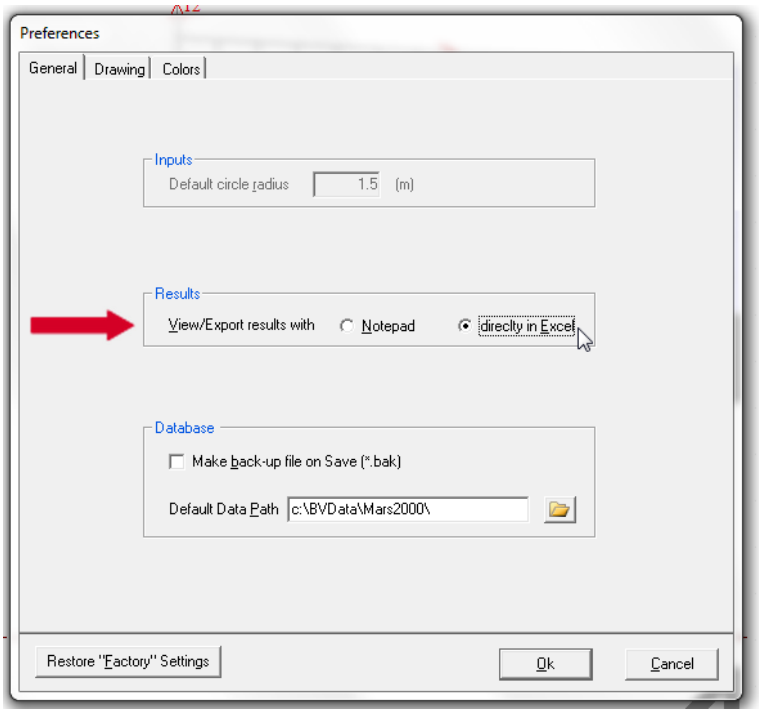

Results View
<<
>>
Close
hc values as computed by default at section's x = 129.42 m
hc if fully filled hold ..... 17.673 m
hc homogeneous loading condition if partially filled hold ..... 15.887 m
hc alternate loading condition if partially filled hold with MHO + 0.1 * MH ..... 4.546 m
hc alternate loading condition if partially filled hold with MHO ..... 3.972 m
hc values as used in the bulk pressure computations
hc if fully filled hold ..... 17.673 m
hc homogeneous loading condition if partially filled hold ..... 15.887 m
hc alternate loading condition if partially filled hold with MHO + 0.1 * MH ..... 4.546 m
hc alternate loading condition if partially filled hold with MHO ..... 3.972 m

4.2.3. Export of results

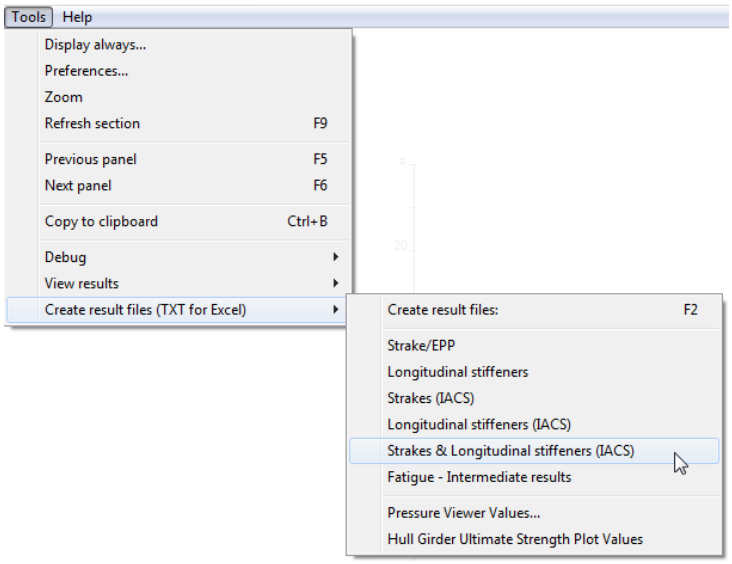
It is possible to export to Excel a synthesis of the results under several templates.

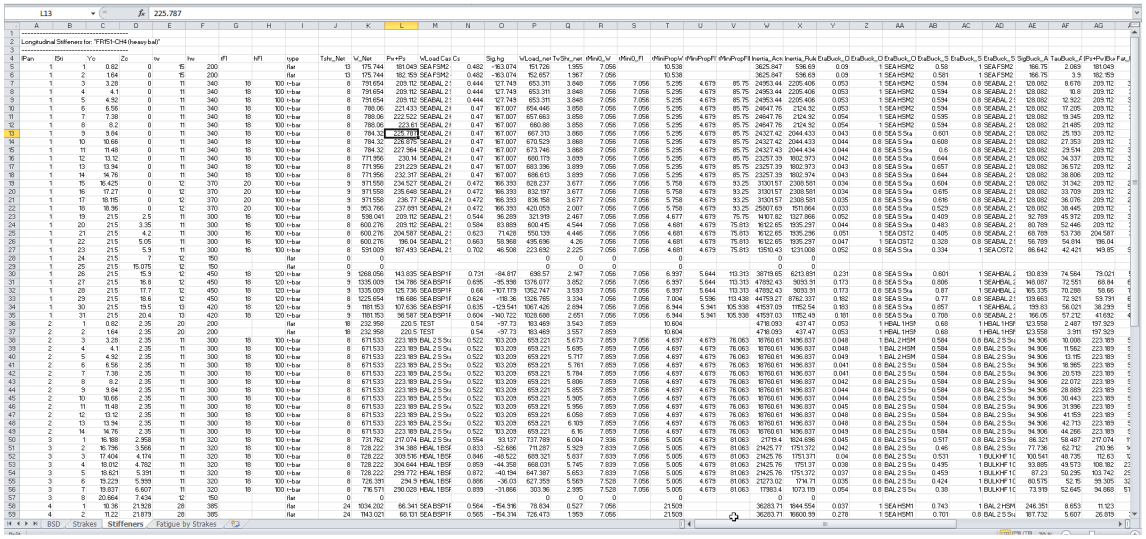
First, for convenience, the setting to directly open the export file into Ms Excel can be activated through the menu “Tools” ➔ “Preferences”.





The different export syntheses are available under the menu “Tools” ➔ “Create result files”.





4.3. Calculation Options and Results for Bulkhead Arrangements

The calculation options and result display are completely similar to those of bulkhead arrangements under the "old" CSR rules sets. There are as well printable results, intermediate results files and export files for Excel.
Therefore no further detail is required here for this document.

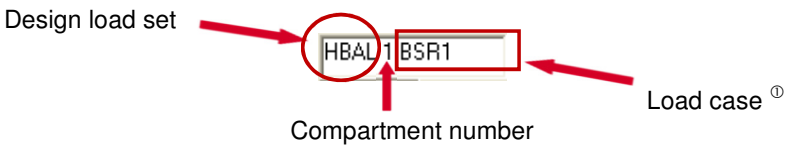
Appendix A – CSR H implementation within MARS

Rule Topic	Rule Ref.	Status in MARS 2000	Comments
Hull Girder Strength			
↳ Hull Girder Bending assessment	Pt1 Ch5 S1 2	Available	-
↳ Hull Girder Shear assessment	Pt1 Ch5 S1 3	Available	Based on direct calculation of the shear flow (uncorrected shear force)
↳ Shear correction for OT ships	Pt1 Ch5 S1 3.4 & 3.5	Available soon	Expected 3rd Quarter 2015
↳ Ultimate Strength	Pt1 Ch5 S2	Available	-
↳ Residual Strength	Pt1 Ch5 S3	Available	-
Hull Local Scantling			
↳ Minimum net thicknesses	Pt1 Ch6 S3	Available	-
↳ Yielding for plates	Pt1 Ch6 S4	Available	-
↳ Yielding for stiffeners	Pt1 Ch6 S5	Available	• Mono-span stiffeners with reduced end fixity assessed as continuous stiffeners and not by direct analysis • Ch6 S5 1.1.4 not checked in MARS2000
Buckling			
↳ Slenderness	Pt1 Ch8 S2 2 & 3	Available	-
↳ Buckling capacity for buckling criteria			
↳ Plane Plate Panels	Pt1 Ch8 S5 2.2 & T3	Available	• In-section stresses not known in MARS 2000 • Ch8 S5 2.2.5 Tripping brackets in way of adjacent plate panel not considered for F_{tran} of transversely framed EPP of single side skin bulk carrier, between the hopper and top wing tank
↳ Curved Plate Panels	Pt1 Ch8 S5 2.2.6	Not in MARS	-
↳ Stiffeners	Pt1 Ch8 S5 2.3	Available	In-section stresses not known in MARS 2000
Fatigue			
↳ Design fatigue life	Pt1 Ch9 S1 Symbols	Available	-
↳ Fatigue stress range	Pt1 Ch9 S3 3.1	Available	• Always computed with $f_{warp} = 1$ • Ch9 S3 T1 No.1: no post weld treatment (for connection types 31 & 32)
↳ Simplified stress analysis	Pt1 Ch9 S4	Available	• No stress due to relative displacements for BC ships • Ch9 S4 T4 Note (2) not included
Other Structures			
↳ Fore part	Pt1 Ch10 S1	Available	-
↳ Bottom slamming	Pt1 Ch10 S1 3.2	Available	The actual plastic section modulus of bulb stiffeners based on equivalent angle scantlings
↳ Tank subject to sloshing	Pt1 Ch10 S4	Available	• Wash bulkheads not known • No assessment of transverse stiffeners of sections
BC ships specifics			
↳ Cargo hold side frames of single side bulk carriers	Pt2 Ch1 S3 1.1	Available	Net shear sectional area criteria expressed as net shear thickness ($A_{shr} = t_{shr} \cdot d_{shr}$)
↳ Steel coils	Pt2 Ch1 S3 2	Not in MARS	-
↳ Transverse vertically corrugated watertight bulkheads separating cargo holds in flooded conditions	Pt2 Ch1 S3 3	Available	-
↳ Grab requirement for Plating	Pt2 Ch1 S6	Available	-
OT ships specifics			
↳ Primary Supporting Members in Cargo Hold region	Pt2 Ch2 S3 1	Available	All but horizontal stringers Rule values provided by MARS 2000
↳ Vertically corrugated bulkheads	Pt2 Ch2 S3 2	Available	-

Appendix B – Dominant case labelling within MARS

Local results represent each the worst case over several loading conditions, design load sets and/or load cases.

Here is how to understand the abbreviations:



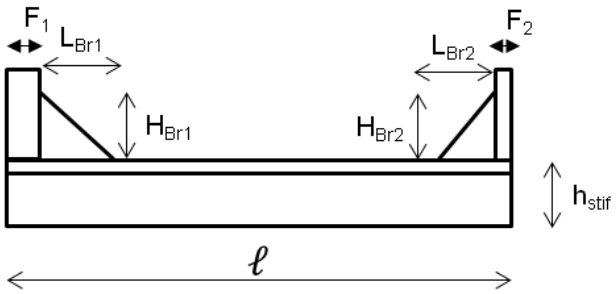
① : (S+D) cases refer to CSR H – Pt 1, Ch4, Sec 2, 1.1.1
(S) cases identified by “S”, “S Sta” or “Sta” in function of the display context

The design load sets labelling in MARS 2000 is as follows:

MARS label	*Meaning*
SEA	Sea pressure
LIQ	Liquid pressure (all types but ballast)
BAL	Ballast liquid pressure in normal ballast condition
HBAL	Ballast liquid pressure in heavy ballast condition
WBX	Ballast liquid pressure in water ballast exchange condition
HWBX	Ballast liquid pressure in heavy water ballast exchange condition
BULKHF	Bulk pressure in homogeneous fully filled condition
BULKHM	Bulk pressure in homogeneous partially filled condition (heavy cargo)
BULKAm	Bulk pressure in alternate fully filled condition (light cargo)
BULKAM	Bulk pressure in alternate partially filled condition (heavy cargo)
SEALIQ	Differential pressure (LIQ – SEA)
SEABAL	Differential pressure (BAL – SEA)
SEAHBAL	Differential pressure (HBAL – SEA)
SEAWBX	Differential pressure (WBX – SEA)
SEAHWBX	Differential pressure (HWBX – SEA)
SEABULKHF	Differential pressure (BULKHF – SEA)
SEABULKHM	Differential pressure (BULKHM – SEA)
SEABULKAm	Differential pressure (BULKAm – SEA)
SEABULKAM	Differential pressure (BULKAM – SEA)
FLOOD	Liquid pressure in flooded condition
Tst	Liquid pressure in test condition
SLA	Bottom slamming pressure
Slosh	Sloshing pressure
UniCarg	Pressure from distributed load carried on deck (user input static load)
AccDeck	Pressure on accommodation deck (static load = 3 kN/m²)

Appendix C – MARS 2000 computation of effective spans

MARS 2000 works with an approximate method relative to the CSR H rules (ref: Pt 1, Ch 3, Sec 7, 1.1) to evaluate the effective bending span, ℓ_{bdg}, and the effective shear span, ℓ_{shr}, of mono-span stiffeners.
Here is described how MARS 2000 proceeds.



For all stiffeners:

- Effective bending span (all dimensions in m)

$$\ell_{bdg} = \ell - (F_1 + F_2) - \left(L_{Br1} \times \max\left(1 - \frac{h_{stif}}{2H_{Br1}}\ ;\ 0\right)\right) - \left(L_{Br2} \times \max\left(1 - \frac{h_{stif}}{2H_{Br2}}\ ;\ 0\right)\right)$$

- Effective shear span (all dimensions in m)

$$\ell_{shr} = \ell\ -\ \max\left(F_1 + L_{Br1}\ ;\ \frac{s}{4}\right)\ -\ \max\left(F_2 + L_{Br2}\ ;\ \frac{s}{4}\right)$$

NOTE: For longitudinal stiffeners of cross sections, the “total flat at ends” input is used for F_1 value

With

- ℓ : full stiffener length between supports
- h_{stif} : stiffener height
- F_1 : flat at start end of stiffener, if any
- $\{L_{Br1} \times H_{BR1}\}$: dimensions of bracket at start end of stiffener, if any
- F_2 : flat at last end of stiffener, if any
- $\{L_{Br2} \times H_{BR2}\}$: dimensions of bracket at last end of stiffener, if any